DETAILED DESCRIPTION

[0013] Exemplary embodiments of the present invention relate generally to continual learning in slowly-varying environments, and more particularly, to providing an optimized action to an external system. Exemplary embodiments recognize without such a system to continually learn, human intervention and expertise is needed to monitor and adapt to changes in the environment. Exemplary embodiments for continual learning when the behavior of the environment varies slowly with time are described below with references to FIGS. **1-3**.

[0014] Implementation of such exemplary embodiments may take a variety of forms, and exemplary implementation details are discussed subsequently with reference to the Figures.

[0015] FIG. **1** is a functional block diagram illustrating a data processing environment **100**, according to an exemplary embodiment. FIG. **1** provides an illustration of one implementation of the subject matter and does not imply any limitations in which different exemplary embodiments of the data processing environment may be implemented. Many modifications to the depicted data processing environment may be made by those skilled in the art without departing from the scope and range of equivalents of the subject matter. In some exemplary embodiments, data processing environment **100** includes a network **106**, a server **104**, which operates continual learning system **102**, and a decision agent **108**.

[0016] Network **106** interconnects server **104** and decision agent **108**. In general, network **106** can be any combination of connections and protocols capable of supporting communications between server **104**, decision agent **108**, and continual learning system **102**. Network **106** can include wire cables, wireless communication links, fiber optic cables, routers, switches, firewalls, or any combination that can include wired, wireless, or fiber optic connections known by those skilled in the art.

[0017] Server **104** can be a web-based server hosting continual learning system **102**, in accordance with exemplary embodiments of the present invention. In one exemplary embodiment, server **104** can be any programmable electronic device or computing system capable of receiving and sending data, via network **106**, and performing computer-readable program instructions known by those skilled in the art. In some exemplary embodiments, server **104** can include a data storage repository (not shown) for storing data including, but not limited to, state information for all entities associated with an environment, transaction data, and various models or policies. Data storage repository can be any programmable electronic device or computing system capable of receiving, storing, and sending files and data, and performing computer readable program instructions capable of communicating with server **104** and decision agent **108**, via network **106**. In some exemplary embodiments, server **104** can be a cluster of computer nodes, in the distributed system, operating continual learning system **102**, via network **106**. In an exemplary embodiment, server **104** includes databases (not shown) that provides a service to external systems. In another exemplary embodiment, continual learning system **102** resides locally on server **104**. In yet another exemplary embodiment, continual learning system **102** resides locally on one or more computer nodes.

[0018] In some exemplary embodiments, server **104** includes continual learning system **102** that utilizes components or models in order to select and provide an optimized action to decision agent **108**. For example, continual learning system **102** utilizes a decision engine **202** to perform various functions for receiving one or more action requests from a decision agent **108**. Continual learning system **102**, utilizing the decision engine **202**, can select a model providing an optimized action. Continual learning system **102**, utilizing orchestrator **212**, can deploy a first model to the decision engine **202**, initiate an observation period, and initiate a test period. In another example, continual learning system **102** utilizes a model builder **210** to build the second model. In a final example, continual learning system **102** utilizes an evaluator **214** to determine a performance score for the first model and a performance score for the second model.

[0019] In some exemplary embodiments, continual learning system **102** operates on a central server, such as server **104**, and can be utilized by one or more decision agents, such as decision agent **108**, via a mobile application downloaded from the central server or a third-party application store, and executed on the one or more decision devices. In another exemplary embodiment, continual learning system **102** may be a software-based program, downloaded from a central server, such as server **104**, and installed on one or more decision agents, such as decision agent **108**. In yet another exemplary embodiment, continual learning system **102** can be utilized as a software service provided by a third-party cloud service provider (not shown).

[0020] In some exemplary embodiments, decision agent **108** is an agent to the server **104** and can be for example, a desktop computer, a laptop computer, a smart phone, or any other electronic device or computing system, known by those skilled in the art, capable of communicating with the server **104** through the network **106**. For example, decision agent **108** may be a laptop computer capable of connecting to a network, such as network **106**, to access continual learning system **102** and to provide requests for actions and rewards. In other exemplary embodiments, decision agent **108** can be any suitable types of mobile devices capable of running mobile applications or a mobile operating system.

[0021] In an exemplary embodiment, decision agent **108** interacts with an environment (e.g. a clothing retailer website or a news website). Decision agent **108** may request continual learning system **102** for an action. In another exemplary embodiment, decision agent **108** may provide the state of the environment (e.g. the duration of a user on articles of the news website, or the dollar amount of clothing purchases by a user) in the request. It can also be appreciated by those skilled in the art that decision agent **108** can provide an identifier of the entity corresponding to the request in lieu of the state of the environment.

[0022] FIG. **2** is a functional block diagram depicting components of continual learning system **102**, according to an exemplary embodiment. In some exemplary embodiments, the components reside locally with continual learning system **102**. In another exemplary embodiments, the components, either individually or collectively, reside remotely from continual learning system **102** and are connected to continual learning system **102**, via network **106**.

[0023] In some exemplary embodiments, Decision Engine **202** receives a request for an action from Decision Agent **108**. Decision Engine **202** retrieves parameters associated with a model from Model Database **208**. Model Builder **210** builds a first model offline which it seeds to Model Database